GULKANA HATCHERY POLICY PAPER

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INTRODUCTION

The Gulkana Hatchery Complex, consisting of two incubation facilities (Gulkana I and II), is located above Paxson Lake on the East Fork of the Gulkana River in the upper Copper River drainage (Figure 1). The Gulkana facilities are operating near their permitted sockeye salmon egg capacities of 35.5 million and 1.25 million eggs respectively. In addition, the Gulkana II facility is permitted to incubate 250,000 chinook eggs. Sockeye salmon fry from the Gulkana Hatchery Complex are released at four locations; (1) Gulkana I hatchery site, (2) Summit Lake, (3) Crosswind Lake, and (4) Gulkana II site. Chinook salmon fry are released into the East Fork Gulkana River or at Monsoon Lake.

AREAS OF CONCERN

Personal use, subsistence, and sport fisheries all benefit from the Gulkana Hatchery salmon returns, but the primary user is the commercial fishery in the Copper River District which accounts for 85% to 95% of the harvest of sockeye and chinook salmon in the Copper River system. In the Copper River District, hatchery fish are mixed with the wild stock returns to the Copper River system's "upriver" and "delta" spawning components. At the present permitted production level, potential mean annual adult returns would be approximately 250,000 sockeye and 2,500 chinook salmon. The recent ten year average annual commercial harvest in the Copper River fishery is approximately 650,000 sockeye and 34,000 chinook salmon. Thus, the hatchery component could increase the commercial harvest by 23% and represent nearly 20%, assuming a 60% exploitation rate. The contribution by hatchery chinook salmon would be less than 7% of the harvest.

Wild sockeye salmon returns to the Copper River district have been grouped into two major stocks based on geographic spawning areas: (1) an upriver and (2) a delta stock. Each stock is itself composed of many discrete spawning populations. Because the three stock components, hatchery, upriver, and delta, all return to spawn within the same time period, they are mixed in the commercial fishing district. This provides little opportunity, at present funding levels, for stock specific management. Therefore, all stocks are assumed to be exploited equally by the commercial fishery.

The delta stock consists of wild sockeye salmon populations which spawn in the coastal river systems south of the Chugach Mountains, east of Cordova and west of the Bering River. Spawning escapements to these systems are monitored by weekly aerial surveys of individual salmon spawning streams and lakes.

The escapement of upriver stocks past the commercial fishery is monitored at the Miles Lake Sonar Project, located approximately 30 miles above the commercial district. The commercial fishery is managed to achieve an escapement goal at Miles Lake partitioned over time based on historic run timing curves. The escapement goal at Miles Lake is based on three components; (1) wild stock spawning needs, (2) personal use, subsistence and sports fishery allocations, and (3) hatchery stock requirements. The hatchery component includes brood stock needed for future production as well as any hatchery returns which could not be

harvested by the commercial fishery without over exploiting wild stocks. The exploitation rate for all stocks is based on the forecasted run of wild stocks. If forecasts are accurate for wild and hatchery stocks, desired wild stock escapement levels will be met when the Miles Lake escapement goal is achieved. However if forecasts are incorrect, desired wild stock escapement levels may not be met even though the Miles Lake goal is achieved.

Sockeye salmon management is further complicated by stocks spawning in the Copper River delta systems. Since hatchery stocks augment the upriver escapement component, maximizing harvest of the upriver stock could result in over harvest of the delta stock. There is concern that the delta stocks can not sustain the same level of exploitation as the upriver run. Aerial survey estimates for 1986-1990 were 46% below the previous 10 year average (1976-1985) and 23% below the 20 year average (1966-1985). Under the current management strategy the escapement goal for the upriver run has been easily met which is not true for delta stocks.

Consistent evaluation of hatchery programs throughout the area, including the Gulkana facility, must be applied. Guidelines for evaluation and selection of proposed hatchery and remote release sites stress that overlap in run timing of hatchery and wild stocks be minimized. The purpose of this objective is to avoid mixed stock management problems which might jeopardize the integrity and productivity of wild stocks. Development of enhanced salmon returns must be accompanied by appropriate research programs to allow for harvest of total returns without determent to wild stocks.

Additional information and a more detailed explanation of specific areas of concern are presented in Appendix A. Due to these concerns, it is necessary to develop a policy of present and future salmon enhancement for the Gulkana Facility.

STATEMENT OF POLICY FOR THE GULKANA HATCHERY COMPLEX

It is the policy of the Department not to compromise its current level of wild stock management precision for increased harvests in the Copper River fisheries. Hatchery production at the current level or at an increased level must occur in conjunction with evaluation programs that ensure maintenance of wild stock escapements. The Department will manage the Copper River fisheries to achieve wild stock minimum escapement goals.

THE GULKANA HATCHERY POLICY'S IMPACT ON CURRENT PRODUCTION LEVELS

At current production levels, wild stock productivity can be maintained as long as preseason planning assumptions (i.e. forecasts for hatchery and wild stocks and relative exploitation rates) are accurate. If survival of hatchery stocks differ from wild stocks, forecasts may not be accurate and escapements of upriver wild stocks may deviate from the desired goal. Achievement of upriver and delta stock escapements has become more difficult with the steady decline of delta escapements in recent years.

Success in meeting wild stock management objectives is difficult to assess since information concerning the abundance and distribution of hatchery and wild stocks is just now becoming available. A more extensive assessment program needs to be designed and implemented to address these needs. This program must provide estimates of the hatchery returns by release site as well as detailed migratory timing information. Studies are also needed to differentiate delta and upriver components, and to more accurately estimate delta escapements. A list of programs, various combinations which would achieve these objectives, is provided in Appendix B of this document.

RECOMMENDATIONS

The drafters of this policy recommend that production for the Gulkana Hatchery complex not be increased above current permitted levels until an adequate evaluation program to address management concerns has been completed. Additionally, stock assessment programs must be continued to assure wild stock management is not compromised.

The drafters of this policy feel that it is important for the State to recognize that fisheries enhancement programs place a burden on management of surrounding wild stocks and create new management complications. In calculating costs of enhancement projects (i.e. new hatchery facilities, lake stocking areas, remote release sites, or stream side incubation facilities) funding of evaluation and increased management needs must be included as a part of the project budget.

GULKANA TASK FORCE SIGNATURES

James Brady — 9-10-90
James Brady — Date

Sam Sharr — 9-11-90
Sam Sharr — Date

Ken Roberson — 9/19/90
Ken Roberson — Date

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Craig Whitmore — Date

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APPENDIX A.
FISHERIES MANAGEMENT AND RESOURCE MONITORING OF COPPER RIVER BASIN SOCKEYE AND CHINOOK SALMON

INTRODUCTION

Sockeye salmon spawn throughout the Copper River basin and can be categorized into two stock groupings. One is an "upriver" run which includes sockeye salmon stocks which spawn in the Copper River watershed upstream of Miles Lake (River Mile (RM) 30). The other is a "delta" run consisting of all sockeye salmon stocks which spawn in the coastal lakes and streams of the Copper River delta and Bering River watersheds. The upriver run is composed of more than 100 individual sockeye salmon stocks. A portion of the upriver run consists of hatchery-reared sockeye salmon produced from Gulkana River stock eggs incubated at the Fisheries Rehabilitation Enhancement and Development (F.R.E.D.) Division Gulkana Hatchery Facility and released into Summit and Crosswind Lakes as well as at the hatchery. The delta run is composed of approximately 30 sockeye salmon stocks.

Chinook salmon spawn almost exclusively in the upriver tributaries of the Copper River. Forty chinook spawning stocks have been identified. Enhancement of the Gulkana River chinook stock also occurs at the Gulkana Hatchery Facility.

Sockeye and chinook salmon are harvested in a commercial fishery in the Copper River District in the Gulf of Alaska. Subsistence and personal use fishermen harvest sockeye and chinook salmon in the Copper River. Sport anglers harvest sockeye and chinook salmon in tributary streams of the Copper River.

Commercial Fishery

In 1988, 520 fishermen with drift gill net permits made deliveries during the Copper River salmon fishery (ADF&G 1990). The 1978-1988 average harvest has been 675,718 sockeye and 33,740 chinook salmon. An increasing proportion of the harvest is comprised of hatchery-reared sockeye salmon. The hatchery run will increase from 72,000 (1984-88 average) to an average 220,000 sockeye salmon for 1989-1992 (Table 1). The Copper River District sockeye fishery is managed to obtain a weekly escapement past a counting station below Miles Lake, Copper River (RM 30). Delta stock escapements are estimated from aerial surveys which must be done late in the fishery. This delay makes it difficult for managers to estimate delta run strength and react in a timely fashion.

The current management strategy continues to place top priority in obtaining wild stock escapement goals, past the counting station below Miles Lake and to this end has adjusted the weekly escapement schedule to account for the presence of hatchery stocks. This is accomplished by estimating the exploitation rate of wild upriver sockeye salmon stocks by fishery which would provide adequate wild stock

escapement and applying that same rate to the expected hatchery run. Surplus hatchery salmon are then added to weekly escapement objectives based on historic run timing of the Gulkana stock acquired from coded wire tag (CWT) return data.

To successfully achieve the escapement schedule, the following assumptions must be met:

1. Abundance forecast of upriver and hatchery stocks is accurate.

2. Forecast of run timing for upriver and hatchery stocks is accurate.

3. Annual upriver exploitation rate is the same for all stocks and allows adequate delta run escapement.

4. Juvenile and marine survival rates are equal for wild and hatchery stocks.

5. Proportion of wild and hatchery stocks is accurately assessed during the season.

If assumptions 1 through 4 are not fulfilled the importance of assumption 5 increases.

Most chinook salmon are caught during the first five to six weeks of the sockeye salmon fishery. When allowed, large mesh gill nets are used by many commercial fishermen early in the season to target chinook salmon. Chinook salmon management decisions are based on comparisons of reported catches to forecasted returns apportioned over time using historic catch curves. Chinook catches are managed through time closures or gill net mesh size restrictions. Fishery closures to protect chinook salmon are most effective during the first days of the fishery, prior to the arrival of large numbers of sockeye salmon. Gill net mesh size restrictions are generally not imposed until the second or third fishing period. Incidental chinook catches have increased, even with use of smaller meshed gill nets designed to target primarily on sockeye salmon. Following the first week, the fishery is managed for sockeye salmon.

Subsistence and Personal Use Fisheries

The largest personal use and subsistence fisheries occur in the upper Copper River at or above Wood Canyon (RM 95) where dip nets and fish wheels are used. The average number of personal use and subsistence permits issued during 1979-1988 was 4,273 for dip net and 477 for fish wheel. A 60,000 salmon guideline harvest apportioned among weekly periods, has been established for the Copper River personal use dip net and fish wheel fishery. The average catch for the personal use and subsistence fisheries in 1984-1988 has been 2,337 and 563 chinook and 40,505 and 21,985 sockeye salmon, respectively. The number of chinook and sockeye salmon harvested by the personal use fishery is controlled by limiting the allowable catch per permit. In recent years, an increased use of boats in the personal use dip net fishery has allowed participants to fish offshore and catch more chinook salmon.

Sport Fishery

Chinook and sockeye salmon are both targeted by sport fishermen in the Copper River Basin. During 1984-1988 fishing effort ranged from 28,000 angler days (1984 and 1986) to over 37,000 angler days (1987) for anadromous and resident fishes. The Gulkana and Klutina Rivers support the greatest amount of fishing effort directed at salmon in the Copper River Basin. In recent years these two systems have shown a trend of increasing use by individuals and guided parties. The Gulkana River chinook salmon annual harvest during 1984-1988 averaged 1,730 fish. During 1989, between June 16 and July 31, approximately 30,000 angler hours was expended on the Gulkana River, downstream of the West Fork, and 2,398 chinook salmon were caught of which 1,461 were kept and 937 released. The 1984-1988 average annual sockeye salmon harvest was approximately 2,500 fish. The directed sockeye salmon fishery has not shown an increase in effort and occurs from late June into September. The Klutina River chinook salmon annual harvest during 1984-1988 averaged 520 fish. During 1989 approximately 416 boat trips and 3,700 angler hours were expended on the Klutina River in the chinook salmon fishery. Approximately 1,587 chinook salmon were caught, 1,033 were kept, and 554 released. The 1984-1988 sockeye salmon annual harvest was approximately 1,000 fish. The sockeye salmon fishery has not shown an increase in effort. Approximately 1,400 sockeye salmon were taken in 1988.

Prior to the 1989 season, due to the increasing effort directed at chinook salmon within the Copper River Basin, spawning season closures and reduced bag and possession limits were implemented through the Board of Fisheries. It is not anticipated that further restrictions will be implemented although closures of specific systems can occur in response to conservation concerns (e.g. inadequate escapement). Harvest information is obtained through the State Wide Harvest Survey Questionnaire. In response to major changes of fishing effort during the season, creel surveys of specific systems may be conducted to verify results of the State Wide Harvest Survey or to gain specific fishery information not available from the survey.

EXISTING FISHERIES MONITORING AND RESEARCH PROJECTS

The Department monitors sockeye and chinook salmon resources in the Copper River Basin by collecting information on harvests and spawning populations. These data are obtained through programs which enumerate catches and escapements and describe the age, sex, size, and stock composition of runs.

Catch and Escapement Enumeration

Catches

Commercial Fisheries. Commercial period catches are obtained during the season from preliminary catch reports from processors. Daily catch and effort data by

district and statistical area are tabulated after the season from sales receipts (fish tickets) which must be provided to fishermen by processors at each sale. The price paid to fishermen, called ex-vessel value, is based on the price per pound and weight of the landing. Therefore, numbers of salmon landed is often estimated by dividing the landed weight by an estimated average weight of salmon by species. The average weight and its variance are not reported on fish tickets. Consequently the variance for the catch in numbers of salmon is unknown, but the difference between the actual and reported number of fish harvested is thought to be minor.

Subsistence and Personal Use Fisheries. Catches in these fisheries are estimated during and after the season from information recorded on permits returned to the Department. The precision and accuracy of catch estimates is a function of the accuracy of data from each returned permit and the percent of permits returned. In recent years the return rate has averaged 65% and 88% for the subsistence and personal use fisheries. In 1989, 94% of personal use permits were returned. It is assumed that a large portion of permits which are not returned are held by fishermen that did not catch salmon. The rate of return is, therefore, not directly proportional to the percent of catch reported and is estimated by a linear regression model.

Sport Fisheries. The State Wide Harvest Survey has been the method used to evaluate recreational fishery effort and harvest. Creel surveys do not occur on an annual basis and none are being conducted during 1990.

Escapements

Delta Wild Stock. Escapements of delta sockeye salmon runs are estimated from peak counts made during weekly aerial surveys of selected spawning sites and migratory corridors. Migratory timing curves (expected cumulative weekly proportions of total run) and mean annual escapements for major stocks are based on historic data (1972-present). These migratory timing curves and mean historic escapements are used to estimate the expected cumulative escapement each week of the season, effectively becoming escapement goals. These numbers are compared with aerial survey observations to determine whether escapement goals will be met.

Aerial counts are treated as relative indices of escapement for comparison between years and stocks since 1) survey conditions are variable and affect counting success, 2) the portion of the escapement actually visible from the air during a survey is unknown and, 3) stream life estimates are not available.

Upriver Wild Stock. Escapement of the upriver sockeye salmon run is estimated with hydroacoustic equipment located immediately downstream of Miles Lake, Copper River (RM 30). The river channel at the Miles Lake site is approximately 1,200 feet wide. The sonar counts fish as they pass through a 60 ft sonar beam emitted from transducers located on each shore. During typical conditions, strong mid-channel currents are thought to force most sockeye salmon to travel through the sonar beams. However, if water levels are low and mid channel currents lessen, sockeye salmon could travel farther offshore, beyond the range of the hydroacoustic equipment. Additionally, deployment of hydroacoustic equipment

during the first two weeks of the season is often not possible because of low water and ice bergs. During most years several days of significant fish passage occurs prior to equipment operation.

The hydroacoustic equipment used is unable to distinguish fish species, so the upriver escapement estimate is for all salmon combined. Again, strong currents and ice bergs prohibit systematic test fishing to obtain estimates of species composition. The hydroacoustic estimate is used as an estimate of sockeye salmon escapement from the commercial fishery. Estimating escapement of the much less numerous chinook salmon is not a goal of the project.

The migratory timing curve scaled to the escapement goal for the upriver sockeye run is used to determine expected weekly escapements. The abundance of discrete upriver spawning populations cannot be estimated during the season except for stock groups which share similar historic timing based on spaghetti tagging at Miles Lake (1970-1972) and Wood Canyon (1967-1972). However, it is assumed that use of the migratory timing curve will assure adequate escapement across all segments of the run. Aerial surveys are flown two or three times during the summer to assess the relative distribution of the upriver escapement to the various spawning sites.

Chinook salmon escapement is estimated from aerial surveys flown at the peak of spawning. Peak aerial survey counts are expanded to represent total escapement based on the relationship between aerial survey counts and mark-recapture population estimates from 1966-1968 and 1970-1971.

Upriver Hatchery Stock. The hatchery run is mixed with the wild delta and upriver runs and is included within the total escapement estimate of the upriver run at Miles Lake sonar. Escapement estimation must occur closer to the hatchery/release sites to adequately assess the total abundance of the hatchery run. Sockeye salmon from the Gulkana Incubation Facility are released at the Gulkana I and II hatchery sites, Summit, and Crosswind Lakes.

Escapement of hatchery sockeye salmon to Summit Lake which contains few wild sockeye salmon is estimated from aerial surveys and partial ground counts. Escapement of hatchery sockeye salmon to Paxson Lake tributaries, which are a mixture of wild and hatchery stocks (Gulkana site I and II releases), cannot be fully estimated. Aerial surveys will be used to estimate escapements into Crosswind Lake, which contain few wild sockeye salmon. The enhanced chinook salmon return to the Gulkana River from Monsoon Lake releases will also be counted by aerial surveys beginning in 1992.

Age, Sex, and Size Sampling

The objective in setting sample sizes for most age, sex, weight, and length (AWL) samples obtained from Copper River salmon fisheries is to simultaneously estimate the proportion of each age class in catch or escapement time-area strata within ± 5 percentage points of the true proportion 90% of the time. Samples are taken in the middle of each time-area stratum in stratified systematic designs or at the peak of abundance in unstratified designs. This objective is applicable for

commercial catch and delta wild stock escapement sampling.

Commercial Catches

AWL data for Copper River District commercial catches are estimated using a stratified systematic sampling design. In the sockeye salmon fishery, strata are weekly periods for the first six weeks of the season when catches are greatest and age composition changes are most rapid. The remainder of the fishery (July and August) is divided into two or three progressively longer time strata. Strata in the chinook salmon fishery are weekly periods during the portion of the run when 90% of the catches occur (May 15 - June 10). Sample size per stratum has averaged 590 sockeye and 545 chinook salmon (1985-1987).

Subsistence and Personal Use Catches

AWL data for sockeye salmon in subsistence and personal use catches are also estimated using a stratified systematic sampling design. Strata are weekly periods through the first five weeks of the season when catches are greatest and age composition changes are most rapid. One or two longer strata are sampled later in the season. Sample size per stratum has averaged 486 sockeye salmon (1985-1987). Chinook salmon are not sampled.

Escapements

Delta Wild Stock. Only major sockeye salmon escapements of the delta run are sampled. The logistics and expense of sampling numerous, isolated watersheds in this coastal area precludes multiple visits. Sockeye are sampled once at each selected spawning area at approximately the peak of abundance. Sample size per stratum has averaged 703 sockeye salmon (1985-1987).

Upriver Wild Stock. AWL data collected from the subsistence and personal use fishery are assumed to be representative of the sockeye salmon escapement to the upper Copper River. Daily sonar counts, shifted to account for travel time between Miles Lake and Chitina are stratified to match age composition strata in upriver catches.

Carcasses from the chinook salmon escapement to the Gulkana River are sampled for AWL data. Unfortunately, sample sizes are too small in most years to achieve desired levels of accuracy and precision. Grounds surveys are being expanded into other chinook salmon spawning tributaries to increase the number of samples collected. However, there is also concern that carcass samples may not represent all age classes present or provide accurate sex ratio estimates.

Upriver Hatchery Stock. The sockeye escapement of the Summit, Crosswind, and Paxson Lake (Gulkana I and II release) hatchery runs are not currently sampled for AWL data. The mixture of wild and enhanced stocks in the Paxson Lake system precludes obtaining a sample of pure hatchery fish.

Stock Identification Projects

Upriver Wild Stock Versus Delta Wild Stock

The contribution of the delta and upriver runs to the commercial catch of sockeye salmon in the Copper River District since 1982 has been estimated using scale patterns analysis (SPA). Linear discriminant models are constructed for each major age group in the fishery using scale measurements from escapement samples. These models generally have classification accuracies of 75% to 80%. Scale samples are collected in conjunction with the catch and escapement AWL sampling program described earlier. Analyses are completed after the season

An SPA project was developed after feasibility studies during 1980 and 1981 indicated that it was possible to separate upriver and delta stocks using SPA although it was not possible to discriminate among smaller stock groupings. The ratio of upriver to delta stocks in catches has varied from 47% to 25% among years. Spatial differences in the run composition of catches have not been detected during these studies, but temporal changes in the run have been documented. In general, the catch of upriver run sockeye salmon is larger during the first five or six weeks of the fishery (Figure 2). By late June the contributions of the two runs are approximately equal and remain so thereafter. The upriver run peaks in late May or early June, while the delta run peaks early to mid June. Timing differs by slightly over one week (Figure 3).

Wild Versus Hatchery Stocks

The contribution to the commercial catch of hatchery sockeye salmon released into Summit Lake has been estimated from coded wire tag (CWT) recoveries. A feasibility study was done in 1981 when approximately 1,500 smolt from Summit Lake were tagged and their adipose fins clipped. Approximately 20,000 smolt were tagged each year from 1982 through 1985. Unfortunately, total smolt migration from Summit Lake has never been estimated after an unsuccessful attempt. Catches from the Copper River commercial fishery have been scanned for tagged sockeye salmon since 1984. Currently 30% of the catch from each fishing period is scanned. Assuming a 10% survival rate from smolt to adult, there should have been 2,000 tagged sockeye salmon passing through the district annually from 1985 through 1988, of these about 1,200 should have been caught and 400 tags recovered. A recovery of this size would allow weekly estimates of hatchery run contributions to the commercial fishery to be made throughout most of the season.

However, only about 65 recoveries have been made in the commercial catch each year from 1985 to 1988. The reasons for this poor tag recovery have not been identified but could include 1) inadequate recovery procedures, 2) a high rate of tag loss (i.e. sockeye salmon with missing adipose fins but no CWT), or 3) a higher than estimated mortality rate for tagged sockeye salmon. It is unlikely that poor recovery procedures are to blame. CWT recovery samplers are all experienced and sockeye salmon are processed relatively slowly for the fresh/frozen market. Therefore, each sockeye salmon can be examined closely and sampling error is unlikely. Tag loss does not appear to be excessive, but there may be a high proportion of naturally missing adipose fins within wild

stocks. When this occurs in hatchery fish it can not be distinguished from tag loss or tag rejection. The average percent of sockeye salmon missing adipose fins without CWT estimated on the spawning grounds of Summit Late was 29% for 1985-1988. Average percent in samples from the commercial fishery for this same period was 83%. A higher than estimated mortality rate for tagged fish may be responsible for the poor recovery rates in 1985-1989. Each year capture, handling, and release techniques were improved. In addition, for 1986, the number of smolt tagged was increased to 50,000 to improve tag recovery in the 1989 commercial fishery. In 1989, 230 tags were recovered in the commercial fishery representing 40% of those with missing adipose fins. Budget cuts resulted in a cessation of tagging in 1987 and 1988. Tagging was resumed in 1989, and 50,000 smolt have been tagged annually. There appears to be a large number of sockeye salmon with natural missing adipose fins. In 1990, when few tagged sockeye salmon were expected to be present (3 and 6 year old fish) commercial catch samplers collected 269 heads from sockeye salmon with missing adipose fins (through statistical week 27). None of these heads contained tags.

In 1989, 12 million hatchery fry were released into Summit Lake; 50% of total production. The remaining fry were released into Paxson (38%) and Crosswind Lakes (12%). In 1990, 5.1 million fry were released into Crosswind Lake, 12 million into Summit and 10 million into Paxson Lake at the Gulkana I and II hatchery sites. Seven thousand smolt were tagged from the 1989 release into Crosswind Lake. The annual goal for Crosswind Lake was increased to 50,000 CWT smolt in 1990.

Fry released into Summit Lake are thought to have a lower survival rate than those released into Paxson or Crosswind Lakes. Therefore assuming commercial fisheries contribution rates for Paxson and Crosswind Lakes to be the same as that estimated from Summit Lake tag data is probably incorrect. Timing of adult returns may also differ between release sites. Recovery of tagged sockeye salmon from Crosswind Lake will help to answer these questions.

The percent of Summit Lake sockeye salmon smolt which was tagged is estimated from escapement sampling during the year of return. Gunn Creek, the only significant tributary into Summit Lake, is walked at least once (in 1985) and an average of twice each year. The percent tagged has ranged from 0.43% (1988) to 3.13% (1986).

The chinook salmon enhancement project is relatively new. Eggs were first collected from the Gulkana River system for incubation in 1987. The current plan is to collect 50,000 eggs per year, release fry into Monsoon Lake, and tag all migrating smolt captured. This will continue for a life cycle to evaluate results before allowing incubation to increase towards the permitted maximum of 250,000 eggs.

APPENDIX B.
PROPOSED FISHERIES MONITORING AND RESEARCH PROJECTS FOR COPPER RIVER SOCKEYE AND CHINOOK SALMON

To ensure continued productivity of wild sockeye salmon stocks of the Copper River drainage, escapement goals must be determined and appropriate measures taken to achieve these goals each year. The Department's success in achieving these goals depends on the accuracy of abundance forecasts, timing predictions, and the assumption that delta stocks can withstand the same exploitation rate as upriver stocks (Appendix A). Success in achieving the chinook salmon escapement goal (15,000) is more difficult since this species is mixed with, but much less abundant than, sockeye salmon. Again the Department's ability to forecast abundance and timing is the key to achieving the chinook salmon escapement goal.

Forecasts have been quite accurate since 1985. The average forecast error has been 9% for sockeye and 17% for chinook salmon (Table 2). Based on CWT recovery estimates, (Table 1), the average forecast error for the sockeye salmon hatchery run was 23% for 1988 and 1989. It is more difficult to evaluate run timing forecasts. Recoveries of large numbers of tags, as was achieved in 1989 (230 tags), will allow examination of inter-annual variations in run timing for the hatchery run. Since tagging was not done in 1987 and 1988 information obtained on run timing from tag releases made during 1989-1990 will be important in management of runs in 1992 and 1993.

The hatchery component of the upriver run appears to have the latest mean date of arrival in the commercial fishery (Figure 4). It's average entry pattern was estimated from CWT recovery data (1984-1989) and appears bimodal, overlapping completely with both the upriver and delta wild stocks (1984-1987). The average hatchery contribution to the commercial fishery has been small (97,900) in comparison to the wild stocks (Figure 4). Yet, when average returns reach the maximum permitted level (250,000) the hatchery run could represent 20% to 25% of the commercial catch. This increase in hatchery production will alter overall run timing and stock composition (delta versus upriver). Protection of delta run stocks may become increasing difficult at increased levels of enhancement. Estimates of delta run escapement cannot be made in a timely manner, and the accuracy of these estimates is unknown. Unfortunately, recent delta sockeye salmon escapements (60,300; 1986-1989) have been half the amount seen the previous ten years (115,800; 1976-1985). If the delta run cannot support the same level of exploitation as the upriver run, the addition of hatchery sockeye salmon may lead to over-exploitation of the delta run.

If timing and abundance forecasts are not accurate managers will need weekly estimates of hatchery contributions to determine exploitation rates on wild stocks. This will require preseason estimates of the percent of the hatchery run which was tagged. Until 1989, only sockeye salmon released into Summit Lake were tagged. In 1989, tagging of Crosswind Lake smolt began. While these releases represent an average, 64% of the total release, survival and adult migratory timing may not be the same among release sites (the first return of Crosswind CWT will be in 1992). This would make estimates of hatchery contributions to the commercial fisheries inaccurate since these estimates assume equal survival,

return timing, and commercial exploitation for all hatchery releases (Table 1). Large annual variability (CV= 75%) in the tagged to untagged ratio (Table 2) also makes it difficult to expand commercial sampling results using an historic mean. Management of these stocks would benefit from either a preseason, brood-year specific, estimate of the percent of the hatchery run tagged or a reduction in the variance of the historic mean.

An expanded program of fisheries research and monitoring projects is needed to implement the Gulkana Hatchery Policy. The following is a list of projects, various combinations of these and/or others should fulfill policy objectives.

ESCAPEMENT ENUMERATION

1. Place weirs on major delta run spawning systems to estimate adult sockeye salmon abundance. Conduct research to estimate stream life and develop a model to convert aerial survey indices into total abundance estimates.

2. Upgrade Miles Lake hydroacoustic gear by purchasing dual beam equipment. Evaluate mid-channel salmon passage, determine the need for multiple transducers, and evaluate our ability to count chinook salmon.

3. Place weirs on the outlet of Crosswind and Summit Lakes to count the return of hatchery run sockeye salmon to those release sites.

AGE, SEX, AND SIZE SAMPLING

1. Develop a multiple strata sampling design for estimating age, sex, and size composition for escapements enumerated with weirs.

2. Estimate the age, sex, and size composition of hatchery adult sockeye salmon at each release site. If future results show no difference in age composition and percent tagged among sites, sample only major release groups.

STOCK IDENTIFICATION PROJECTS

1. Increase catch sampling goals for the delta/upriver run scale pattern analysis project to estimate stock composition on a weekly basis.

2. Evaluate the ability to estimate stock composition (minimum upriver versus delta) during the season using presence of parasites, DNA (nuclear or mitochondrial), genetic stock identification (GSI), otolith marking, or any discriminating feature among these stocks.

3. Tag (CWT) hatchery run smolt from all release sites. At a minimum, tag smolt from release sites where they predominate (over wild stock) and represent a substantial percent of total release (i.e. Summit, Crosswind, and Monsoon Lakes).

4. Increase funding of the smolt tagging project to allow tagging crews to begin before June 1 to insure tagging is conducted in proportion to abundance across the entire run.

5. Enumerate smolt migrating from each release site. At a minimum, estimate the number of smolt migrating from Summit and Crosswind Lakes. This will provide preseason estimates of tag to untagged ratios, which are needed to estimate commercial catch contribution rates during the season.

6. As all hatchery sockeye salmon are released into the Gulkana River and its tributaries, treat the entire Gulkana return (wild and hatchery runs) as enhanced. Enumerate and tag migrating smolt at a common downriver location. Use this tag rate to estimate commercial catch contributions of the Gulkana System return.

7. Tag (half-length CWT) a percent (to be determined later) of the sockeye salmon fry prior to stocking. Use different tag codes for each release site. At a minimum, tag fry released at the Gulkana Facility that rear in Paxson Lake. Holding facilities for rearing fry will be needed to evaluate tag retention before release.

MODELING OR DATA ANALYSIS PROJECTS

1. Use data from escapement monitoring and stock identification projects to reconstruct the upriver and delta runs and estimate run specific exploitation rates. This information can be used to evaluate run timing and escapement goals.

2. Estimate fishery specific exploitation rates for the Copper River chinook salmon return. Evaluate present escapement goal and management strategy. Prepare a plan to prevent over harvest.

3. Determine sample sizes needed for CWT placement into sockeye and chinook salmon to obtain weekly estimates of catch contributions.

4. Estimate the contribution of hatchery stocks to the upriver run for each brood year. Estimate brood year production.

5. Document, in a Department publication, forecast and total run estimation methods used for Copper River sockeye and chinook salmon.

Table 1. Estimates of the hatchery component of the upriver Copper River sockeye run, based on Summit Lake survival rates.

Year	Brood Year[a]	Comm. Catch[b]	Percent Scanned for Tags[c]	Tags Recovered	Fish Per Tag[d]	Est. Summit Lk Return[e]	% Summit[f]	Est. Enhanced Catch[g]	Expl. Rate[h]	Total Enhanced Return[i]	Preseason Estimate[j]	Published Forecast[k]
1984	1979	899,776	27.9%	3	94	1,012	55%	1,839	62.6%	2,936	24,461	
1985	1980	931,132	29.3%	44	67	10,052	35%	28,720	68.1%	42,178	52,492	55,500
1986	1981	780,808	31.5%	74	32	7,506	25%	30,024	60.5%	49,607	80,332	82,300
1987	1982	1,180,782	31.9%	87	84	22,913	46%	49,810	70.9%	70,205	94,129	99,000
1988	1983	576,950	37.7%	54	234	33,532	44%	76,209	54.2%	140,722	108,191	118,000
1989	1984	1,025,923	42.2%	230	157	85,878	45%	190,841	67.7%	281,692	208,469	210,000
1990	1985						64%				235,856	234,000
1991	1986						56%				223,977	
1992	1987						57%				212,217	
1993	1988						50%					

[a] Assumed all sockeye salmon return as 5 year old adults.
[b] Commercial catch includes Copper River District (212) only.
[c] Percent of catch scanned and number of tags decoded from FRED tag lab database.
[d] Ratio of tagged to untagged sockeye salmon from escapement sampling at Summit Lake.
[e] Estimated Summit Lake catch contribution = Tags Recovered/ Percent Scanned * Fish per Tag
[f] Represents the percent of total hatchery fry released into Summit lake.
[g] Total enhanced catch contribution = Summit Lake Estimate / Percent Summit Lake
[h] Exploitation rate = Commercial Catch / (Commercial Catch + Miles Lake Sonar Estimate)
[i] Total enhanced return = Estimated enhanced catch / exploitation rate.
[j] Preseason estimate of enhanced return = Fry released from brood year * 1%.
[k] Multi-year class forecast published in the Statewide forecast RIR.

Table 2. Accuracy of Copper River sockeye and chinook salmon forecasts.[a]

Year	Sockeye Salmon Forecast	Return	% Error	Chinook Salmon Forecast	Return	% Error
1985	1,780,000	1,645,000[b]	8%	45,000	50,000	-10%
1986	1,559,000	1,433,000	9%	45,000	68,000[b]	-34%
1987	1,659,000	1,824,000	-9%	47,000	58,000[b]	-19%
1988	1,379,000	1,173,000	18%	50,000	46,000	9%
1989	1,730,000	1,725,000[b]	0%	57,000	51,000[b]	12%
1990	1,373,000			52,000		

[a] Source: annual report (1985-90) titled, *Preliminary forecasts and projections for Alaska salmon fisheries*.

[b] This figure was corrected from that published in footnote [a] by Ken Roberson.

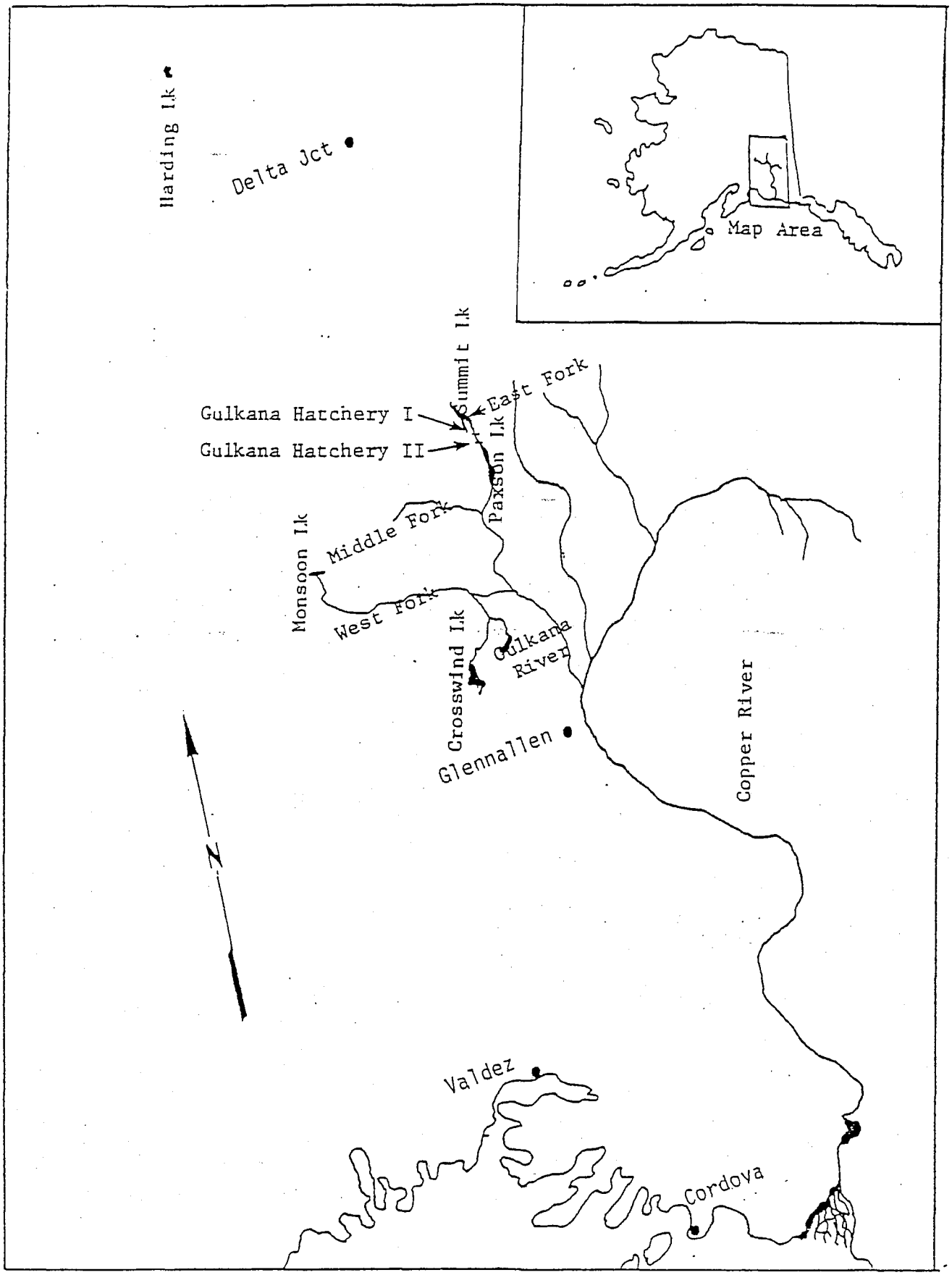

Figure 1. Location of the Gulkana Hatcheries and fry stocking lakes in relation to the Copper River watershed.

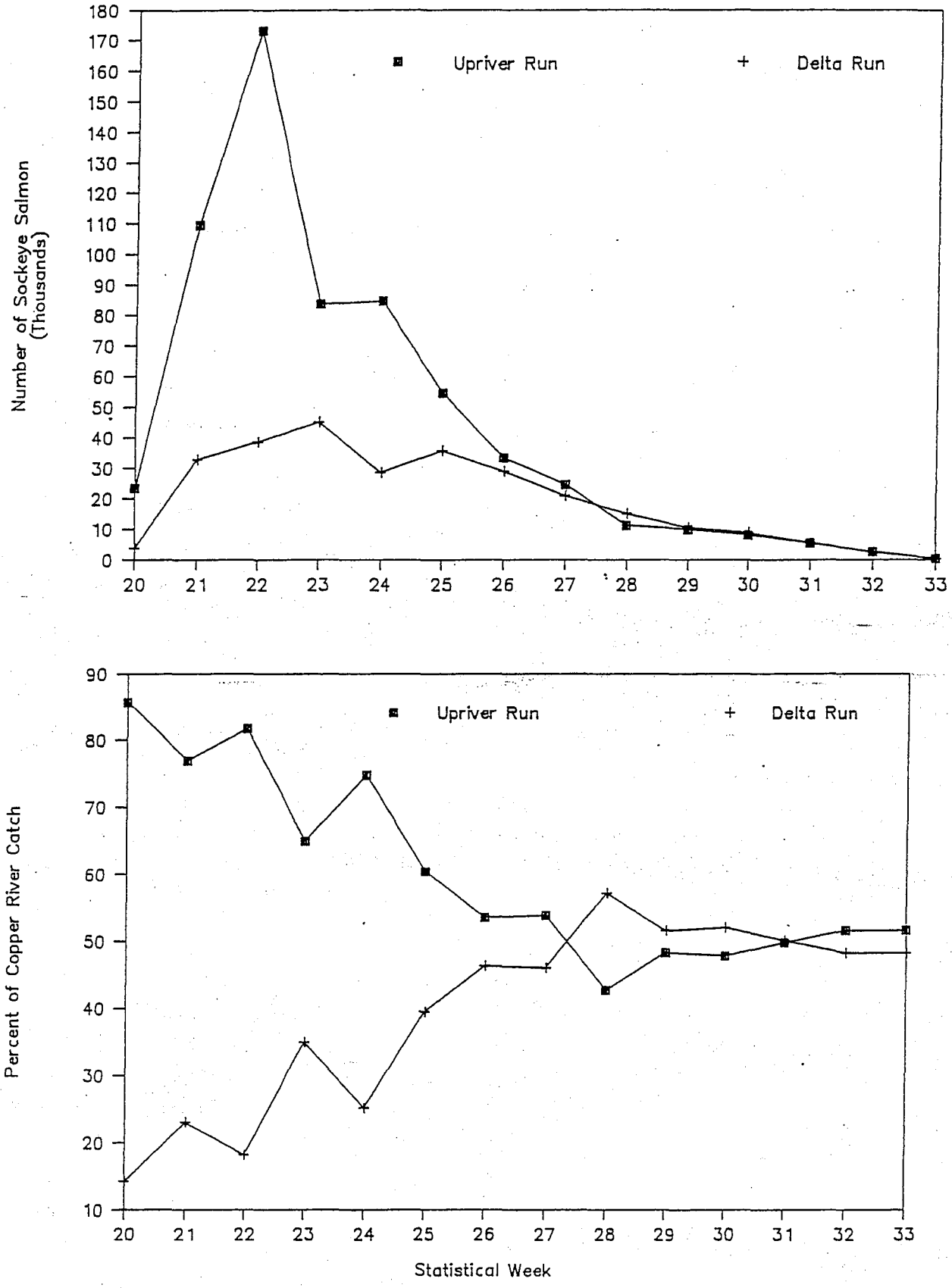

Figure 2. Average number of sockeye (top) and percent (bottom) present in the Copper River District commercial catch (1982–87).

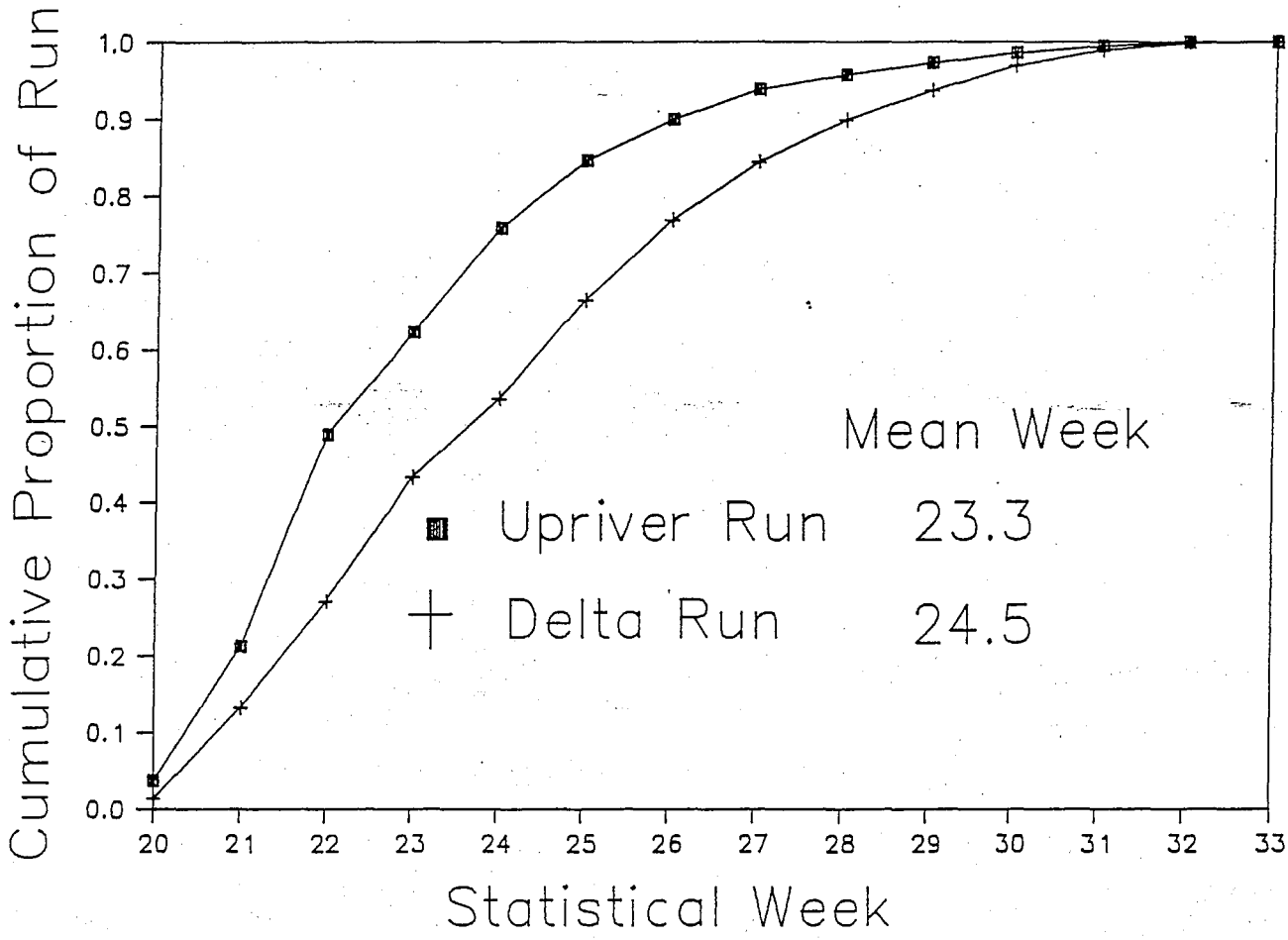

Figure 3. Cumulative proportions of the upriver and delta runs of sockeye salmon in the Copper River District commercial catch by statistical week (1982–87 average).

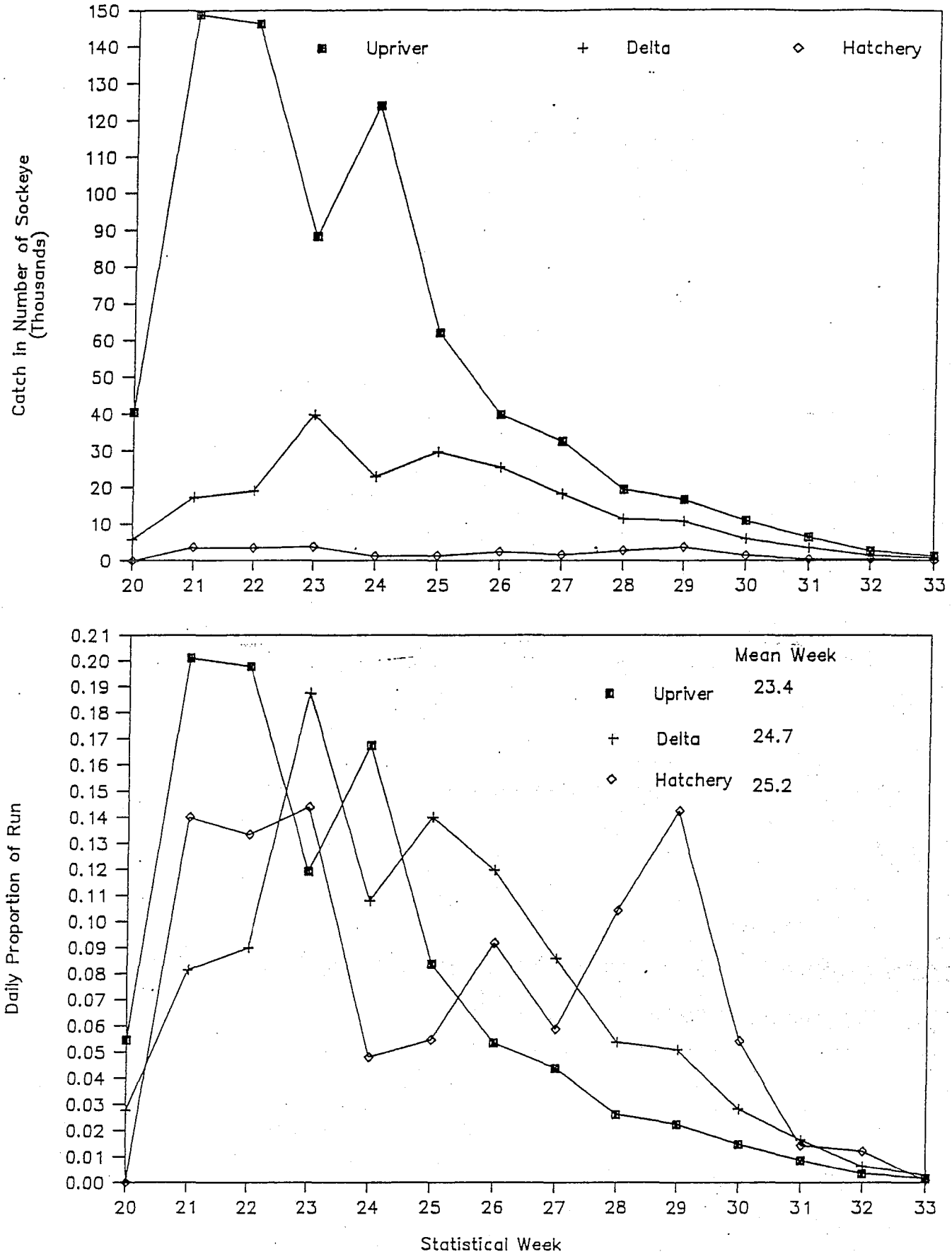

Figure 4. Average number of sockeye (top) and weekly proportion (bottom) present in the Copper R. District commercial catch (1984–89).